Topographic Effects on Ocean Mixing

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LONG-TERM GOALS

To understand and parameterize interior and near-boundary mixing processes.

To understand the dynamical processes occurring in the surface layer of the ocean and parameterize them in ocean models.

To understand the physical oceanography of straits and semi-enclosed seas.

OBJECTIVES

An ongoing objective is to exploit Juan de Fuca Strait as a natural laboratory for the study of rotating stratified shear flows with sloping lateral boundaries. In particular I would like to understand and quantify vertical and lateral transfer of momentum and scalars, the causes and role of cross-strait secondary circulation, and the comparative importance, magnitude and parameterization of internal and near-boundary mixing.

In the surface mixed layer I would like to understand and parameterize the effects of various processes responsible for mixing and for air-sea gas exchange.

For straits I seek to determine the relative importance of hydraulic and frictional processes, and to understand the nature and causes of variations on a variety of time scales.

An ongoing study also seeks to elucidate the comparative importance of turbulence and zooplankton for acoustic backscatter at various frequencies.

APPROACH

For the last several summers we have conducted observational studies in Juan de Fuca Strait involving one or more bottom-mounted 300 kHz broadband ADCPs, temperature and conductivity moorings, and CTD profiles and "towyos". Senior Research Associate Richard Dewey assumes much of the responsibility for this, with assistance from postdoctoral fellows (particularly Kate Stansfield) and graduate students Michael Ott, Keir Colbo, Tetjana Ross and Steven Stringer.

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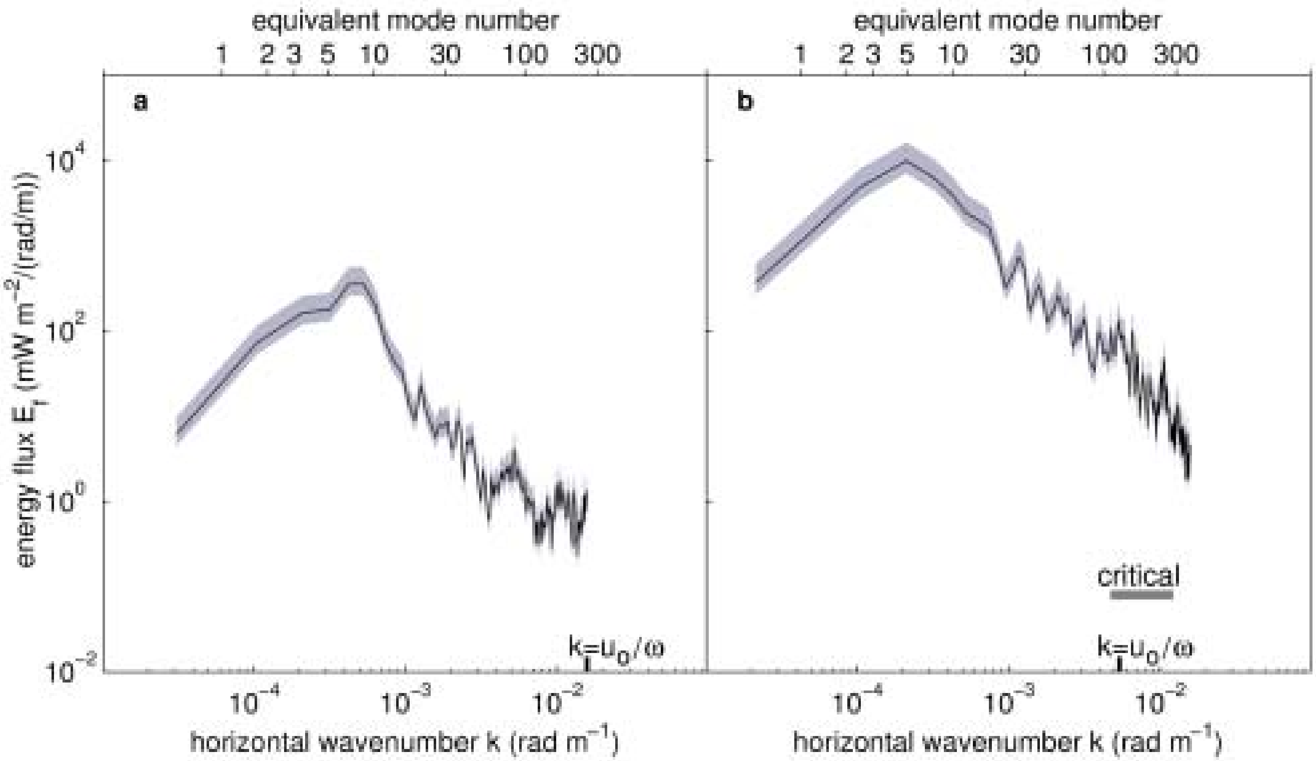

Figure 2. Internal tide energy flux spectra as a function of the horizontal wave number (and equivalent vertical mode number) for (a) the East Pacific Rise and (b) the Mid-Atlantic Ridge. The spectra are red, showing that most of the flux goes into low modes. The wavenumber equal to the tidal excursion is marked and is approximately 0.01 radian/m. The slope also becomes critical at about this scale for the Mid-Atlantic Ridge, but is still subcritical for the East Pacific Rise.

IMPACT/APPLICATIONS

Our results on internal Reynolds stresses in stratified flows have implications for the modeling of internal friction in estuarine and other models, and show the importance of direct measurements rather than relying on circumstantial evidence for verification of model parameterizations.

The role of internal tides in mixing the ocean is receiving much attention. Our study should help to clarify the importance and dominance of mixing remote from the generation site as well as providing accurate estimates of the energy flux from real topography.

The new results on hydraulic flows with entrainment could provide an intuitive basis for understanding real exchange flows.

The earlier results on bubble sizes will provide a useful input to models of air-sea gas exchange and acoustic propagation in the upper ocean.

Ongoing analysis of results from our Knight Inlet study will clarify the relative importance of turbulence and zooplankton in acoustic backscatter at various frequencies, and possibly provide clues to the effect of turbulence on zooplankton behaviour.

The proceedings of the 2001 'Aha Huliko'a, which I con-convened, should reach a wide audience interested in the interaction of stirring and mixing processes in the ocean.

TRANSITIONS

We are collaborating with Professor Parker MacCready and others at the University of Washington.

RELATED PROJECTS

The projects described above are also supported by Canadian funding agencies with equal or greater contributions to salaries and equipment and full provision of shiptime.

PUBLICATIONS

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